

# USING GINI COEFFICIENT FOR ANALYSING DISTRIBUTION OF COMMUNITY FORESTS BY PROVINCES IN NEPAL

Report submitted to Community Forestry Study Center on distribution aspect of community forest by provinces in Nepal

## Executive Summary

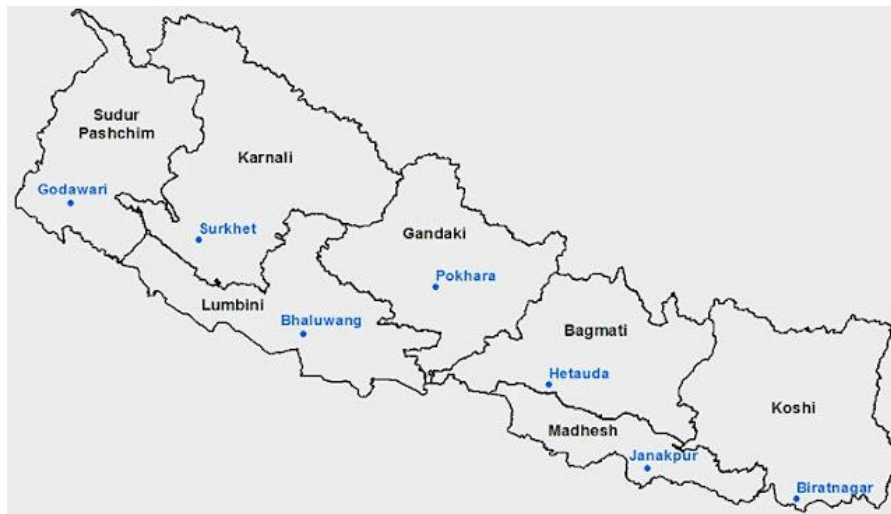
*This report assesses the distribution of community forests in different provinces of Nepal. Community forests in Nepal are handed over without any threshold for per household forest area and an implication of such practice is increased inequality in the distribution of community forests. Using Gini coefficient as a measure of inequality, this report indicates the Gini coefficient of community forestry distribution is lowest for Koshi Province while the coefficient is highest in Gandaki Province. In recent years, the distribution of community forests in Nepal is being directed towards equality. The provision of Initial Environmental Examination (IEE)/Environmental Impact Assessment (EIA) in community forests has acted positively for reducing inequality in the distribution of community forests. For moderating the coefficient, this report also dwells on the provision of limitations on handover of forest area based on per household forest area.*

**Keywords:** Gini coefficient, inequality, community forests, household

## Introduction

An article published in the International Journal of Social Forestry (vol. dated.) entitled "Using Gini-coefficient of Community Forestry by Development and Ecological regions of Nepal" reported on distribution coefficient of Community Forestry in Nepal. However, the country undergone political and administrative reform with seven provinces formed on 20<sup>th</sup> September 2015 in accordance with Schedule 4 of the constitution of Nepal. Namely, provinces Madesh, Koshi, Bagmati, Gandaki, Karnali, Lumbini and Sudurpashchim (see Figure 1). It necessitates research on distribution of community forest by provinces to better understand distribution and future planning of community forest at federal and province level.

Figure 1: Seven Provinces of Federal Republic of Nepal



Nepal extends 800 km east to west along the southern slope of the Himalaya. The country is divided into three ecological zones, namely the Tarai/ Inner Tarai (100-300 m above sea level), the Middle Hills (300-3000 m a.s.l.) and the High Mountains (above 3000 m a.s.l.). The Middle Hills, or Mahabharat Lekh, represent the region where Community Forestry (CF) is widespread. Most of the country's forest occurs in the Middle Hills. The Middle Hills also have the greatest ecosystem and species diversity.

Some equity aspects of CF have been much discussed in Nepal, as exemplified by a compendium of research papers published by Winrock International-Nepal in 2002.<sup>1</sup> The main concern expressed in these papers is that community forests are being handed over in a haphazard way without any consideration on equity aspects. Larger tracts of forests are being handed over to the Forest User Groups (FUGs) comprising fewer households, while a large number of households are included in smaller patches of community forests. This has led to a situation where material benefits are not accruing sufficiently to a large number of forest user households, whereas a few households are using forests indiscriminately.

It necessitates a serious empirical test on equality regarding community forest distribution across different provinces of Nepal. This report attempts to quantify the magnitude of inequality arising due to this discriminatory practice of handover of community forests in Nepal.

### **Materials and method:**

The FUG database provided by the Community Forestry study center has been analysed, considering the data on community forests regarding the area of community forests and beneficiary households across all the seven provinces. One important limitation of this report is that the data used may not be the complete one as the data gathering is a continuous process itself. The data regarding distribution of community forests has also been analysed on the basis of provinces.

In this report, we are using a tool called *Gini concentration ratio* or simply *Gini coefficient* to assess inequality in the distribution of community forests in Nepal. The tool is named after the Italian statistician who first formulated it in 1912. It is an aggregate numerical measure of inequality ranging from 0 (perfect equality) to 1 (perfect inequality) and is used widely to assess income, land and education inequality. The higher the value of the coefficient, the higher the inequality of distribution; or vice versa.

In Nepal, it is feared by many scholars (Bhatta 2002a,b; Tiwari 2002 etc.) that larger tracts of community forests are handed over to small groups of forest users while a large number of households are accommodated as users in smaller patches of community forests. The users in the latter forests can get almost no material benefit from their community forests. Gini coefficient can be quite useful as a tool in such cases to find out whether the distribution of community forests in Nepal has remained equitable or is becoming more inequitable in recent years as feared by the mentioned scholars.

For grouped data, Gini coefficient is calculated by using the following formula (Kanel, 1993).

$$G = \frac{\sum X_i Y_{i+1} - \sum X_{i+1} Y_i}{\sum X_i Y_{i+1} - \sum X_{i+1} Y_i}$$

Where  $X_i$  denotes the cumulative proportion of the population in the  $i$ th class interval, and  $Y_i$  denotes the cumulative proportion of the population in the  $i$ th class interval.

When the variables are measured as percentages, then both of them have to be divided by 100, in this case the above equation has to be written as:

$$G = 1/ (100)^2 [\sum X_i Y_{i+1} - \sum X_{i+1} Y_i]$$

## Results and findings:

The distribution of community forests and number of beneficiary households by Province is given in Table 1. While the distribution of community forests by the size of the forests in different provinces are given in table 2 to 8 respectively.

Table 1. Distribution of Community Forests in Nepal by Province

Province	CF area (ha)	No. of beneficiary Households
Madesh	78854.6	95922
Koshi	432687.6	550285
Gandaki	253407.6	473344
Bagmati	377329.6	519346
Lumbini	395516.9	594386
SudurPaschim	401271.6	543053
Karnali	353096.3	222595

Table 2: Community Forest Distribution by Size of the Forest in Madesh Province, 2023.

CF group	CF (HA)	HH#	HH/CF area
< 10 HA	289.22	4132	0.069995
10-50 HA	2539.12	10675	0.237857
50-100 HA	5287.36	20572	0.257017
100-200 HA	22953.68	27982	0.820302
200-500 HA	38386.64	30065	1.276788
500-1000 HA	5630.68	1229	4.581513
>1000 HA	3767.89	1267	2.973867
Total	78854.6	95922	0.82207

The larger sized community forests are in the hand of fewer households in comparison to smaller sized community forests in which a larger number of households are accommodated in smaller sized community forests. This phenomena appears to be same in all provinces.

Table 3: Community Forest Distribution by Size of the Forest in Koshi Province, 2023.

CF group	CF (HA)	HH#	HH/CF area
< 10 HA	3203.86	44177	0.072523
10-50 HA	25648.59	98637	0.26003
50-100 HA	39447.26	68399	0.576723
100-200 HA	122670.8	142667	0.85984
200-500 HA	185539.6	158514	1.170493
500-1000 HA	47614.49	34305	1.387975
>1000 HA	8562.99	3586	2.387895
<b>Total</b>	<b>432687.59</b>	<b>550285</b>	<b>0.786297</b>

Table 4: Community Forest Distribution by Size of the Forest in Gandaki Province, 2023.

CF group	CF (HA)	HH#	HH/CF area
< 10 HA	4694.31	71432	0.065717
10-50 HA	40945.2	155808	0.262793
50-100 HA	47623.07	94117	0.505999
100-200 HA	76818.12	83618	0.918679
200-500 HA	75847.82	66052	1.148305
500-1000 HA	4410.05	1831	2.408547
>1000 HA	3069	486	6.314815
<b>Total</b>	<b>253407.6</b>	<b>473344</b>	<b>0.535356</b>

Table 5: Community Forest Distribution by Size of the Forest in Bagmati Province, 2023.

CF group	CF (HA)	HH#	HH/CF area
< 10 HA	3541.46	48746	0.072651
10-50 HA	40861.11	146847	0.278256
50-100 HA	55202.49	101698	0.542808
100-200 HA	136621.2	134569	1.01525
200-500 HA	128105.4	82064	1.561043
500-1000 HA	12997.9	5422	2.397252
>1000 HA	0	0	0
<b>Total</b>	<b>377329.6</b>	<b>519346</b>	<b>0.726548</b>

Table 6: Community Forest Distribution by Size of the Forest in Lumbini Province, 2023.

CF group	CF (HA)	HH#	HH/CF area
< 10 HA	2601.5	43990	0.059138
10-50 HA	34825.05	138894	0.250731
50-100 HA	53518.54	105396	0.507785

100-200 HA	108378.1	134241	0.80734
200-500 HA	175162.5	154325	1.135023
500-1000 HA	16982.46	10422	1.629482
>1000 HA	4048.77	7118	0.568807
<b>Total</b>	<b>395516.9</b>	<b>594386</b>	<b>0.665421</b>

Table 7: Community Forest Distribution by Size of the Forest in SudurPaschhim Province, 2023.

CF group	CF (HA)	HH#	HH/CF area
< 10 HA	2372.08	31306	0.075771
10-50 HA	26225.25	109185	0.240191
50-100 HA	44312.59	92584	0.47862
100-200 HA	120422.5	151405	0.795367
200-500 HA	175390.8	147039	1.192818
500-1000 HA	23279.32	9085	2.562391
>1000 HA	9269.04	2449	3.784826
<b>Total</b>	<b>401271.6</b>	<b>543053</b>	<b>0.738918</b>

Table 8: Community Forest Distribution by Size of the Forest in Karnali Province, 2023.

CF group	CF (HA)	HH#	HH/CF area
< 10 HA	680.65	10353	0.065744
10-50 HA	20738.51	47222	0.439171
50-100 HA	45744.79	44358	1.031264
100-200 HA	121072.7	64618	1.873668
200-500 HA	127130.1	49235	2.582108
500-1000 HA	16561.06	5059	3.273584
>1000 HA	21168.45	1750	12.09626
<b>Total</b>	<b>353096.3</b>	<b>222595</b>	<b>1.586272</b>

On the basis of Table 2 to 8, Table 9 to Table 15 are constructed, where we used the formula given by Kanel 1993 .

Table 9. Gini Coefficient of Community Forest Distribution by Size of the Forest in Madesh Province

Community forest	Total area %	Total HH %	$X_i$	$Y_i$	$X_i Y_{i+1}$	$X_{i+1} * Y_i$
less than 10 ha	0.366776	4.307667	4.778276	1.320865	12.43362	15.74321
10 to 50 ha	3.220003	11.12883	11.91886	2.602114	404.5892	157.6859
50 to 100 ha	6.705203	21.44659	60.59915	33.94528	3824.831	3045.164
100 to 200 ha	29.10887	29.17162	89.70802	63.1169	7586.023	6085.304
200 to 500 ha	48.68029	31.34317	96.41323	84.56349	9226.005	8425.333

500 to 1000 ha	7.140586	1.281249	99.63323	95.69232	9963.323	9569.232
more than 1000 ha	4.778276	1.320865	100	100	0	15.74321
Total			100	100	<b>31017.2</b>	<b>27298.46</b>
	$G=1/(100)^2 * (31017.2-272298.46)$					
Gini coefficient	<b>0.371874</b>					

Source: Author's computation from data provided by the Community Forestry Study Centre.

Table 10. Gini Coefficient of Community Forest Distribution by Size of the Forest in Koshi Province

Community forest	Total area %	Total HH %	$X_i$	$Y_i$	$X_i Y_{i+1}$	$X_{i+1} * Y_i$
less than 10 ha	0.740456	8.028022	1.979024	0.651662	13.6269715	8.460778
10 to 50 ha	5.927739	17.92471	12.98338	6.885704	463.396502	384.6638
50 to 100 ha	9.116799	12.42974	55.864114	35.6915	3442.20816	3005.583
100 to 200 ha	28.35089	25.92602	84.21004	61.61752	6235.52306	5750.875
200 to 500 ha	42.88073	28.8058	93.3318	74.04726	8583.91016	7349.898
500 to 1000 ha	11.00436	6.234042	99.25954	91.97197	9925.9542	9197.197
more than 1000 ha	1.979024	0.651662	100	100	0	0
Total			100	100	<b>28664.6191</b>	<b>25696.68</b>
	$G=1/(100)^2 * (28664.6191- 25696.68)$					
Gini coefficient	<b>0.29679</b>					

Table 11 Gini Coefficient of Community Forest Distribution by Size of the Forest in Gandaki Province

Community forest	Total area %	Total HH %	$X_i$	$Y_i$	$X_i Y_{i+1}$	$X_{i+1} Y_i$
less than 10 ha	1.852474	15.09093	1.211092	0.102674	0.592825	0.303031
10 to 50 ha	16.15784	32.91644	2.951391	0.489496	42.62938	16.09588
50 to 100 ha	18.79307	19.88343	32.88255	14.44383	1055.833	912.8009
100 to 200 ha	30.31406	17.66538	63.19661	32.10921	3285.759	2632.624
200 to 500 ha	29.93116	13.95433	81.98968	51.99264	6961.668	5102.949
500 to 1000 ha	1.740299	0.386822	98.14752	84.90908	9814.752	8490.908
more than 1000 ha	1.211092	0.102674	100	100	0	0
Total			100	100	<b>21161.23</b>	<b>17155.68</b>
	$G=1/(100)^2 * (21161.23-17155.68)$					
Gini coefficient	<b>0.400555</b>					

Table 12. Gini Coefficient of Community Forest Distribution by Size of the Forest in Bagmati Province

Community forest	Total area %	Total HH %	$X_i$	$Y_i$	$X_i Y_{i+1}$	$X_{i+1} Y_i$
less than 10 ha	0.938559	9.386036	3.444708	1.044005	58.02754	39.04082
10 to 50 ha	10.82902	28.27537	37.39524	16.84542	1598.895	1239.867
50 to 100 ha	14.62978	19.58194	73.60263	42.75666	4588.284	3772.523
100 to 200 ha	36.20739	25.91124	88.23241	62.3386	7995.088	6175.35
200 to 500 ha	33.95053	15.80141	99.06143	90.61397	9906.143	9061.397
500 to 1000 ha	3.444708	1.044005	100	100	0	0
more than 1000 ha	0	0			0	0
Total			100	100	<b>24146.44</b>	<b>20288.18</b>

	$G=1/(100)^2 * (24146.44-20288.18)$
Gini coefficient	<b>0.385826</b>

Table 13. Gini Coefficient of Community Forest Distribution by Size of the Forest in Lumbini Province

Community forest	Total area %	Total HH %	$X_i$	$Y_i$	$X_i Y_{i+1}$	$X_{i+1} * Y_i$
less than 10 ha	0.657747	7.400915	1.023665	1.197538	3.020778	6.367792
10 to 50 ha	8.804946	23.36764	5.317403	2.950944	153.7512	146.3798
50 to 100 ha	13.53129	17.73191	49.60438	28.91471	2554.603	2226.607
100 to 200 ha	27.40163	22.58482	77.00601	51.49953	5331.237	4662.629
200 to 500 ha	44.28698	25.96377	90.5373	69.23144	8383.671	6877.607
500 to 1000 ha	4.293738	1.753406	99.34225	92.59908	9934.225	9259.908
more than 1000 ha	1.023665	1.197538	100	100	0	0
Total			100	100	<b>26360.51</b>	<b>23179.5</b>
	$G=1/(100)^2 * (26360.51-23179.5)$					
Gini coefficient	<b>0.318101</b>					

Table 14. Gini Coefficient of Community Forest Distribution by Size of the Forest in Sudurpaschim Province

Community forest	Total area %	Total HH %	$X_i$	$Y_i$	$X_i Y_{i+1}$	$X_{i+1} * Y_i$
less than 10 ha	0.591141	5.764815	2.309917	0.450969	4.906074	3.657947
10 to 50 ha	6.535536	20.10577	8.111305	2.123918	236.8524	110.0615
50 to 100 ha	11.04304	17.0488	51.82006	29.20028	2957.921	2389.467
100 to 200 ha	30.01022	27.88034	81.83028	57.08062	6066.031	5301.266
200 to 500 ha	43.70875	27.07636	92.87332	74.12942	8751.934	7369.12
500 to 1000 ha	5.801388	1.672949	99.40885	94.23519	9940.885	9423.519
more than 1000 ha	2.309917	0.450969	100	100	0	0



Total			100	100	<b>27958.53</b>	<b>24597.09</b>
	$G=1/(100)^2 * (27958.53-24597.09)$					
Gini coefficient	<b>0.336144</b>					

Table 15. Gini Coefficient of Community Forest Distribution by Size of the Forest in Karnali Province

Community forest	Total area %	Total HH %	Xi	Yi	XiYi+1	Xi+1*Yi
less than 10 ha	0.192766	4.651048	5.995093	0.78181	18.3385	8.353868
10 to 50 ha	5.87333	21.21431	10.68529	3.058918	269.0297	142.8195
50 to 100 ha	12.95533	19.92767	46.68956	25.17757	2530.899	2033.952
100 to 200 ha	34.28887	29.0294	80.7843	54.20697	5988.915	5091.864
200 to 500 ha	36.00437	22.11865	93.93376	74.13464	8956.485	7399.162
500 to 1000 ha	4.690239	2.272737	99.80709	95.34895	9980.709	9534.895
more than 1000 ha	5.995093	0.786181	100	100	0	0
Total			100	100	<b>27744.38</b>	<b>24211.05</b>
	$G=1/(100)^2 * (27744.38-24211.05)$					
Gini coefficient	<b>0.353333</b>					

Based on the findings related with the calculation of Gini coefficient, Koshi province has the lowest Gini-coefficient (0.29679) while Gandaki Province has the highest one (0.400555). Remaining other provinces have Gini coefficients in between these two figures. It suggests more equitable distribution in Koshi province and rather unequitable distribution in Gandaki province.

There is no change in the percentage of area of forests of larger size (more than 1000 hectares) while the percentage of households having larger tracts of forests (> 500-1000 ha and >1000 ha) as community forests has slightly decreased. It shows that the larger size community forests are not handed over in recent years. The mandatory provision of Initial Environmental Examination (IEE)

and Environmental Impact Assessment (EIA) can be attributed to this decrease in the handing over of large tract of community forests<sup>2</sup>.

This slight decrease in the Gini coefficient implies that the mandatory provision, though having received its share of criticism in every nook and corner of the country, has nevertheless produced the desired result regarding the distribution of community forests in the provinces of Nepal.

## Conclusion

As a conclusion, it can be said that the calculated *Gini coefficient* for Provinces of Nepal (for year 2023) has shown slight reduction as compared with that of the previous years though there have been some limitation regarding the compatibility of data. The mandatory provision of IEE/EIA in community forests has produced this unintended but desired result. If there will be a provision of fixing limits (both small and large) to the size of community forests, it would definitely help in moderating the coefficient of distribution of community forests besides easing the task of monitoring increasing number of community forests by the provincial government. Hence, it is concluded that though the mandatory provision of environmental assessment in certain community forests is being criticized in every nook and corner of the country, it has definitely produced an unintended but desirable outcome in community forestry management in all provinces of Nepal.

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<sup>2</sup> The amended Environmental Regulation in Nepal instituted the provision of Initial Environmental Examination to hand over community forests larger than 200 hectares while Environmental Impact Assessment is essential for handing over community forests larger than 500 hectares.